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Science and Technology for Tomorrow's Air and Space Force

Success Story

TESTING OF YBCO SUPERCONDUCTING COILS COMPLETED

Successful testing of new high-temperature superconducting (HTS) simple coils, made with yttrium barium copper oxide (YBCO)-coated conductor materials, provides an enabling technology that is essential in the development of future compact, high-power airborne generator systems. This successful technology is needed to design and develop future advanced compact, high-power generator coils for aerospace applications.

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Accomplishment

The Propulsion Directorate's Power Generation Branch completed testing of the first superconducting magnetic coils to use industrially made YBCO-coated conductor material. The directorate conducted the tests with Long Electromagnetics, Inc., American Superconductor Corporation, and SuperPower, Inc., using various programs including the Dual Use Science & Technology program. During testing, different coils were made using directorate-developed winding techniques. The YBCO superconducting coated conductor endured significantly greater stresses during the tests and outperformed the earlier generations of HTS conductors.

Background

Compact, high-power generators are needed for airborne directed energy weapons. A Defense Production Act–Title III program was initiated to establish manufacturing facilities for the YBCO-coated conductor.

The testing indicated that no reduction in the n-value, at the 77°K operating temperature, occurred. The n-value describes the relationship of the voltage drop across the wire to the applied current. For the transition from zero resistance (zero voltage drop) to a finite resistance (finite voltage drop), the I-V curve of HTS wires can almost always be fit with the power law $E(j) = Ec\ (j/jc)n$. $E(j)$ is the longitudinal voltage drop across the superconductor, Ec is the electric field criterion, j is the applied current density, jc is the critical current density, and the n is the exponent. For a sharper transition, the I-V curve has a higher n-value. The n-value is often used to determine the quality of the bulk superconducting material.

Propulsion
Technology Transfer

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (04-PR-12)